Two Routes, One Body

Compare how autonomic nerve pathways support changing needs.

HS-AP5-3 "Compare and contrast the actions, origins, and pathways of nerve fibers in the parasympathetic and sympathetic divisions of the autonomic nervous system."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline where each division begins, circle its effects on organs, and number the steps along each nerve pathway. Use different marks for sympathetic and parasympathetic details so you can compare them.

From Sprint to Supper

(1) At the starting line, a runner hears the signal and sprints. Her heart beats faster, her pupils widen, and digestion slows. These coordinated changes are largely driven by the sympathetic division of the autonomic nervous system. Later, as she rests and eats, the parasympathetic division helps slow her heart, narrow her pupils, and increase digestive activity. Neither division is simply switched off when the other is active. Both regulate organs without conscious commands, and their effects often oppose each other. Comparing what they do is only part of the story; their nerve fibers also begin in different places and take different routes.

(2) Sympathetic signals begin in the thoracic and upper lumbar regions of the spinal cord, often called the thoracolumbar outflow. A first nerve fiber, the preganglionic fiber, usually travels a short distance to a ganglion near the spinal cord. There it communicates with a second nerve cell. Its postganglionic fiber usually travels farther to an organ, such as the heart or a digestive organ. Because ganglia near the spine connect to several routes, sympathetic activity can reach many organs during a sprint. This arrangement helps explain how heart rate can rise while digestive activity falls.

(3) Parasympathetic signals begin in the brainstem and the sacral region of the spinal cord, called the craniosacral outflow. Their preganglionic fibers usually travel a long distance before reaching ganglia in or near the organs they control. The postganglionic fibers then travel a short distance to those organs. Both divisions use a two-neuron pathway with a ganglion between the first and second nerve cells, but the typical fiber lengths and ganglion locations differ. After the run, parasympathetic signals can help the runner's heart slow and support digestion while she eats. The two divisions coordinate changing needs rather than acting as simple opposites at every organ.

2 ANSWER WITH EVIDENCE

Use the passage

1. Compare what happens to the runner's heart and digestion during the sprint and while she rests and eats. Which division largely supports each set of changes?

2. How do the places where sympathetic and parasympathetic signals begin differ?

3. Compare the usual locations of the two divisions' ganglia and the lengths of their preganglionic and postganglionic fibers.

4. What pathway feature do the divisions share? How can the location of sympathetic ganglia help signals reach several organs during a sprint?

3 YOUR TURN

Your own words

A student hears a sudden crash while reading, then later relaxes over lunch. In five or six sentences, compare the two divisions' effects on the student's heart and digestion, where their signals begin, and the lengths and routes of their fibers. Include one pathway feature they share.

Two Routes, One Body

PART 1 · READ AND MARK

Underline where each division begins, circle its effects on organs, and number the steps along each nerve pathway. Use different marks for sympathetic and parasympathetic details so you can compare them. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Compare what happens to the runner's heart and digestion during the sprint and while she rests and eats. Which division largely supports each set of changes?	**During the sprint, sympathetic activity raises heart rate and slows digestion. While she rests and eats, parasympathetic activity helps slow her heart and increase digestive activity.**
2	How do the places where sympathetic and parasympathetic signals begin differ?	**Sympathetic signals begin in the thoracic and upper lumbar spinal cord. Parasympathetic signals begin in the brainstem and sacral spinal cord.**
3	Compare the usual locations of the two divisions' ganglia and the lengths of their preganglionic and postganglionic fibers.	**Sympathetic ganglia are usually near the spinal cord, with short preganglionic and longer postganglionic fibers. Parasympathetic ganglia are in or near organs, with long preganglionic and short postganglionic fibers.**
4	What pathway feature do the divisions share? How can the location of sympathetic ganglia help signals reach several organs during a sprint?	**Both divisions use a two-neuron pathway with a ganglion between the neurons. Sympathetic ganglia near the spine connect to several routes, allowing signals to reach many organs.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

When a student hears a crash while reading, sympathetic activity raises heart rate and slows digestion. These signals begin in the thoracic and upper lumbar spinal cord. Short preganglionic fibers reach ganglia near the spine, then longer postganglionic fibers reach organs. Later, during a calm lunch, parasympathetic activity slows the heart and increases digestive activity. Its signals begin in the brainstem and sacral spinal cord, and long preganglionic fibers reach ganglia near or within organs. Short postganglionic fibers finish that route, so both divisions use two nerve cells but differ in their origins, pathways, and effects.

Accept equivalent descriptions of thoracolumbar and craniosacral origins. Fiber lengths and ganglion locations describe the usual pathways, not every autonomic route.